

What is claimed is:

1. A measurement system for measuring the position of a stage, the
2 measurement system comprising:
a first system comprising a first beam source that directs a first
4 beam on a first path and a first redirector that is secured to the stage, the
first redirector redirecting the first beam so that the redirected first beam is
6 on a first redirected path that is 90 degrees from the first path even if the
first redirector is rotated a small angle about an axis.
2. The measurement system of claim 1 wherein the first redirector
2 includes a penta-prism.
3. The measurement system of claim 1 further comprising a first
2 reflector that is positioned away from the stage, wherein the first redirector
redirects the first beam at the first reflector and the first reflector reflects the first
4 beam back at the first redirector.
4. The measurement system of claim 1 wherein the first redirected path
2 is parallel with a first axis, the first path is parallel with a second axis, and the first
redirected path is 90 degrees from the first path even if the first redirector is
4 rotated approximately 0.1 degree about a third axis.
5. The measurement system of claim 1 wherein the first redirected path
2 is parallel with a first axis, the first path is parallel with a second axis, and the first
redirected path is 90 degrees from the first path even if the first redirector is
4 rotated approximately 1 degree about a third axis.
6. The measurement system of claim 1 further comprising an additional
2 system comprising a second beam source that directs a second beam on a
second path that is parallel with the first path; and a second redirector that
4 redirects the second beam so that the redirected second beam is on a second

6 redirected path that is 90 degrees from the second path even if the second
rediretor is rotated approximately 0.1 degree about an axis.

2 7. The measurement system of claim 1 wherein the first redirected path
is parallel with a first axis, the first path is parallel with a second axis, and the first
system measures the sum of the position of the stage along the first axis and
4 along the second axis.

2 8. The measurement system of claim 7 further comprising a second
system that measures the position of the stage along the second axis, wherein the
position of the stage along the first axis is calculated by subtracting the position of
4 the stage along the second axis measured by the second system from the sum of
the position of the stage measured by the first system.

2 9. The measurement system of claim 1 wherein the first redirected path
is parallel with a first axis, the first path is parallel with a second axis, and the first
system measures the position of the stage along the first axis.

2 10. A combination comprising a stage, a stage mover assembly that
moves the stage, and the measurement system of claim 1.

2 11. The combination of claim 10 wherein the first system further
comprises a shield that inhibits environmental conditionals from influencing the
first beam.

2 12. The combination of claim 11 wherein the shield is secured to the
stage.

2 13. The combination of claim 11 wherein the shield defines a shield
aperture and the first beam is directed through the shield aperture.

14. The combination of claim 11 wherein the shield is positioned near at
2 least a portion of the stage mover assembly.

15. The combination of claim 10 further comprising a first optical unit
2 that receives the redirected first beam, the first optical unit being secured to the stage.

16. An exposure apparatus including the combination of claim 10.

17. A device manufactured with the exposure apparatus according to
2 claim 16.

18. A wafer on which an image has been formed by the exposure
2 apparatus of claim 16.

19. A measurement system for measuring the position of a stage along
2 a first axis, the measurement system comprising:

4 a first system comprising a first beam source that directs a first
beam on a first path that is parallel to a second axis; and a first redirector
6 secured to the stage, the first redirector redirecting the first beam so that
the redirected first beam is on a first redirected path that is parallel to the
8 first axis, wherein the first system measures the sum of the position of the stage along the first axis and along the second axis.

20. The measurement system of claim 19 wherein the first redirected
2 path is 90 degrees from the first path even if the first redirector is rotated approximately 0.1 degree about a third axis

21. The measurement system of claim 20 wherein the first redirector
2 includes a penta-prism.

22. The measurement system of claim 19 further comprising a first
2 reflector that is positioned away from the stage, wherein the first redirector
redirects the first beam at the first reflector and the first reflector reflects the first
4 beam back at the first redirector.

23. The measurement system of claim 19 further comprising a second
2 system that measures the position of the stage along the second axis, wherein the
position of the stage along the first axis is calculated by subtracting the position of
4 the stage along the second axis measured by the second system from the sum of
the position of the stage measured by the first system.

24. The measurement system of claim 19 wherein the first system
2 includes a first optical unit that is positioned away from the stage.

25. A combination comprising a stage, a stage mover assembly that
2 moves the stage, and the measurement system of claim 19.

26. The combination of claim 25 wherein the first system further
2 comprises a shield that inhibits environmental conditionals from influencing the
first beam.

27. The combination of claim 26 wherein the shield is secured to the
2 stage.

28. The combination of claim 26 wherein the shield defines a shield
2 aperture and the first beam is directed through the shield aperture.

29. The combination of claim 26 wherein the shield is positioned near at
2 least a portion of the stage mover assembly.

30. An exposure apparatus including the combination of claim 25.

2 31. A device manufactured with the exposure apparatus according to
claim 30.

2 32. A wafer on which an image has been formed by the exposure
apparatus of claim 30.

2 33. An combination for positioning a device, the combination comprising:
a stage that retains the device;
a stage mover assembly that moves the stage; and
4 a measurement system for measuring the position of the stage, the
measurement system comprising a first system including a first beam
6 source that directs a beam at the stage and a shield that inhibits
environmental conditionals from influencing the beam.

2 34. The combination of claim 33 wherein the shield is secured to the
stage.

2 35. The combination of claim 33 wherein the shield defines a shield
aperture and the beam is directed through the shield aperture.

2 36. The combination of claim 33 wherein the shield is positioned near at
least a portion of the stage mover assembly.

2 37. The combination of claim 33 wherein the first system includes a first
redirector that secured to the stage, the first redirector redirecting the first beam
90 degrees even if the first redirector is rotated approximately 0.1 degree about an
4 axis

2 38. The combination of claim 37 wherein the first redirector includes a
penta-prism.

39. The combination of claim 33 wherein the first system includes a first
2 reflector that is positioned away from the stage, wherein the first reflector reflects
the beam back at the stage.

40. An exposure apparatus including the combination of claim 33.

41. A device manufactured with the exposure apparatus according to
2 claim 40.

42. A wafer on which an image has been formed by the exposure
2 apparatus of claim 40.

43. A method for measuring the position of a stage, the method
2 comprising the steps of:

directing a beam on a first path with a beam source; and
4 redirecting the beam with a redirector that is secured to the stage,
the redirector redirecting the beam so that the redirected beam is on a
6 redirected path that is 90° from the path even if the redirector is rotated
approximately 0.1° about an axis.

44. The method of claim 43 further comprising the step of positioning a
2 reflector away from the stage, the redirector redirecting the beam at the reflector
and the reflector reflects the beam back at the redirector.

45. The method of claim 43 wherein the redirected path is parallel with a
2 first axis, the first path is parallel with a second axis, and the redirected path is 90°
from the first path even if the redirector is rotated approximately 1 degree about a
4 third axis.

46. A method for positioning a device, the method comprising the steps
2 of providing a stage, moving the stage with a stage mover assembly, and

measuring the position of the stage by the method of claim 43.

47. The method of claim 46 further comprising the step of securing a
2 shield to the stage that inhibits environmental conditions from influencing the
beam.

48. A method for making an exposure apparatus that forms an image on
2 a wafer, the method comprising the steps of:
providing an irradiation apparatus that irradiates the wafer with
4 radiation to form the image on the wafer; and
positioning the device by the method of claim 46.

49. A method of making a wafer utilizing the exposure apparatus made
2 by the method of claim 48.

50. A method for positioning a device, the method comprising the steps
2 of:
providing a stage that retains the device;
4 moving the stage with a stage mover assembly; and
a measuring the position of the stage with a measurement system,
6 the measurement system comprising a beam source that directs a beam at
the stage and a shield that inhibits environmental conditionals from
8 influencing the beam.

51. The method of claim 50 wherein the shield is secured to the stage.

52. The method of claim 50 wherein the shield defines a shield aperture
2 and the beam is directed through the shield aperture.

53. The method of claim 50 wherein the shield is positioned near at least
2 a portion of the stage mover assembly.

2 54. A method for making an exposure apparatus that forms an image on
a wafer, the method comprising the steps of:
 providing an irradiation apparatus that irradiates the wafer with
4 radiation to form the image on the wafer; and
 positioning the device by the method of claim 50.

2 55. A method of making a wafer utilizing the exposure apparatus made
by the method of claim 54.

2 56. A measurement system that measures the position of a stage along
a first axis, the measurement system comprising:
 a first system having a first redirector that is secured to the stage,
4 the first system directing a first beam to the first redirector on a first path
that is parallel with a second axis, and the first redirector redirecting the first
6 beam on a first redirected path that is parallel with the first axis; and
 a reflector that is positioned away from the stage, the first reflector
8 extending along the second axis; wherein
 the first redirector redirects the first beam at the reflector and the
10 reflector reflects the first beam back at the first redirector; and
 the first redirector is configured to be insensitive to the rotation
12 around a third axis that is orthogonal to the first and second axes about the
direction redirecting the first beam from the first path.

2 57. The measurement system of claim 56 further comprising an
additional system including a second redirector that is secured to the stage, the
additional system directing a second beam to the second redirector on a second
4 path that is parallel with the second axis, and the second redirector redirecting the
second beam on a second redirected path that is parallel with the first axis;
6 wherein
 the second redirector redirects the second beam at the reflector and
8 the reflector reflects the second beam back at the second redirector; and
 the second redirector is configured to be insensitive to the rotation

10 around the third axis about the direction redirecting the second beam from
the second path.

2 58. The measurement system of claim 56 wherein the first redirector
includes a penta-prism.

2 59. The measurement system of claim 56 wherein the first redirector
includes a penta-mirror.

2 60. A combination comprising a stage, a stage mover assembly that
moves the stage, and the measurement system of claim 56.

2 61. An exposure apparatus comprising the combination of the claim 60
and an irradiation apparatus that irradiate a photosensitive substrate held by the
stage with radiation to form an image on the photosensitive substrate, wherein the
4 axis of the radiation irradiated to the photosensitive substrate is substantially
parallel with the third axis.